CHAPTER 11
VALUE ADDITION IN PULSES

11.1 INTRODUCTION

In India, people are mostly vegetarian in dietary habits and depend largely on cereals and pulses as their staple food. Food legumes include those spices of the family Leguminosae that are consumed directly by human beings most commonly as mature dry seeds, but occasionally as immature green seeds or as green pods with the immature seeds enclosed. Food legumes utilized as dry seeds are often referred to as pulses or grain legumes. India is the largest producer of grain legumes in the world. Food legumes provide the high protein component of diet to majority of the population. Pulses are considered as poor man’s meat or also protein tablets. Besides proteins, pulses are important source of carbohydrates, fibre, certain minerals (Ca, Mg, Zn, Fe, k and p) and B-complex vitamins. Food legumes have exponential potential for alleviating human malnutrition in developing countries by virtue of several inherent advantages:

A) Universally, they can grow vigorously under a wider range of environments and on relatively poor soils without supplemental nitrogen, which is particularly advantageous for consistent agriculture in remote areas.

B) Because of their relatively low water requirements, they offer the most important means of increasing food production, farmers income and nutrient contribution in the diet in India’s dry lands, which constitute more than 75% of total cropped area.

C) They have a high supplementation value for cereal protein. Combination of pulses with cereal rich diet is promising in updating the dietary protein quality. As a combination, pulses provide a sufficient lysine to make good the deficiency in cereals. Sulphur containing Amino Acids, deficient in pulses are abundantly provided by cereals resulting protein is far better than present in either of the grains.
Legumes are consumed by humans in many forms. The nutrient bioavailability from legumes depends upon nutrient content and factors such as post harvest handling, processing methods, presence or absence of anti-nutritional and/or toxic factors and possible interaction of nutrients with other food components i.e. Polyphenolic compounds, Phytic acid, certain minerals etc.

11.2 POST HARVEST LOSSES IN PULSES

Out of total production of 14 million tonnes of pulses, about 75% is milled to produce dal in more than 15,000 dal mills scattered all over the world. Processing losses, however, are considerable (between 15%-20%) \(^1\) and increased pulse production cannot help until these losses are reduced. According to various estimates (Kurien et al, 1972\(^2\) & Birewar, 1984\(^3\)), total post harvest losses are 25%-30% \((\text{Table 11.1})\). One estimate puts the milling losses at 1.5 million tonnes valued at Rs 1500 crores (Ali, 1993)\(^4\).

<table>
<thead>
<tr>
<th>STAGE</th>
<th>LOSSES%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting</td>
<td>Not reported</td>
</tr>
<tr>
<td>Handling</td>
<td>Not reported</td>
</tr>
<tr>
<td>Threshing</td>
<td>0.5</td>
</tr>
<tr>
<td>Transport</td>
<td>1.0</td>
</tr>
<tr>
<td>Processing</td>
<td>1.0</td>
</tr>
<tr>
<td>Storage</td>
<td>7.5</td>
</tr>
<tr>
<td>Subtotal</td>
<td>9.5</td>
</tr>
<tr>
<td>Milling</td>
<td>15-20</td>
</tr>
<tr>
<td>Total</td>
<td>25-30</td>
</tr>
</tbody>
</table>

\(^{Source:}\) Ali (1993)

There is a sizeable quantitative and qualitative loss of Black gram during different post-harvest operations like threshing, winnowing, transportation, and storage. The post-harvest losses are reported to be 2.46 percent. The estimated post-harvest losses at various stages are given below in Table 11.2.
Table 11.2: Estimated post-harvest losses of Black Gram

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Stages</th>
<th>Production loss (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Threshing</td>
<td>0.65</td>
</tr>
<tr>
<td>2</td>
<td>Winnowing</td>
<td>0.62</td>
</tr>
<tr>
<td>3</td>
<td>Field to threshing floor</td>
<td>0.70</td>
</tr>
<tr>
<td>4</td>
<td>Threshing floor to storage</td>
<td>0.19</td>
</tr>
<tr>
<td>5</td>
<td>During storage</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2.46</strong></td>
</tr>
</tbody>
</table>


There is a sizeable quantitative and qualitative loss of pulses during different post-harvest operations like threshing, winnowing, transportation, processing and storage. Hence, it is appropriate to give due emphasis to reduce qualitative as well as quantitative losses of pulses during post-harvest operations. It has been reported that about 2.38 percent losses occurred during post harvest operations at the producers’ level (Table 11.3).

Table 11.3: Estimated post-harvest losses of Green Gram at producer’s level

<table>
<thead>
<tr>
<th>S No.</th>
<th>Stages</th>
<th>Production loss (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Losses in transport from field to threshing floor</td>
<td>0.67</td>
</tr>
<tr>
<td>2</td>
<td>Losses in threshing</td>
<td>0.63</td>
</tr>
<tr>
<td>3</td>
<td>Losses in winnowing</td>
<td>0.61</td>
</tr>
<tr>
<td>4</td>
<td>Losses in transport from threshing floor to storage</td>
<td>0.19</td>
</tr>
<tr>
<td>5</td>
<td>Losses in storage at producers level</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td><strong>Total losses at producers level</strong></td>
<td><strong>2.38</strong></td>
</tr>
</tbody>
</table>

Source: Report on Marketable Surplus and post harvest losses of Pulses in India-2002, DMI

The post-harvest losses of pulses can be minimized in the process of threshing, winnowing, storage, processing, handling and transportation.
(i) Threshing and Winnowing

It has been reported that during threshing about 0.63 percent losses and 0.61 percent losses in winnowing are occurred. In order to reduce the losses, threshing and winnowing operations are required to be completed within a short period through improved equipments on the pucca platform.

(ii) Transport Losses

During transportation, it has been observed that 0.67 percent losses are occurred in transporting the produce from the field to threshing floor, losses to the tune of 0.19 percent for transporting the produce from threshing floor to storage. Efficient and quick transportation supported by good packaging material is necessary to reduce the losses.

(iii) Processing

Due to use of old and outdated methods in processing, the loss at this stage has been reported to be up to 1 percent. To reduce the milling losses and to increase the output, improved dal milling method developed by C.F.T.R.I, Mysore should be adopted.

(iv) Storage

Due to improper and inefficient methods of storage, about 7.5 percent loss is estimated during storage. Quantitative losses mainly results from spoilage, dryness or portion of produce, infestation by insects, rodents or birds. Improved scientific storage facilities should be adopted to reduce the losses considerably.

It has been reported that, the storage losses caused by insects, rodents and microorganisms are maximum. Lack of storage facilities forces the farmers to sell their produce at low price. It is essential that during storage, pulses should remain in good condition and not undergo any deterioration due to fungal and insect infection or attack by rodents. Around 80% of storage losses are due to insects, rodents and micro-organisms. The grains in the village are stored in mud-bins, paddy straw mud plastered bin, bamboo mud plastered bin, reed, mud bricks, baked mud plastered pitches, etc. The Indian Grain Storage Institute has also developed modern farm storage capacity of 14.5 million tonnes to meet farmers’ requirements.
Following preventive measures should be adopted to avoid post harvest losses.

1. Harvest at proper stage of maturity to reduce losses.
2. Use proper method of harvesting.
3. Adopt modern mechanical methods, to avoid the losses in threshing and winnowing
4. Use improved technique of processing.
5. Adopt cleaning and grading for remunerative prices inter-alia to avoid financial loss.
6. Use good packaging materials for storage and in transport i.e. B-Twill Jute bags or HDPE bags.
7. Adopt proper technique in storage.
8. Apply pest control measures during storage.
9. Proper handling i.e. (loading and unloading) of pulses with good transportation facilities at farm and market level reduces losses.
10. Avoid use of hooks.

11.3 PULSE PROCESSING TECHNOLOGY

Processing is an important marketing function in the present day marketing of pulses. Processing converts the raw materials and brings the produce nearer to human consumption. It is concerned with value addition to the produce by changing its form. Pulses are generally converted into dal by splitting the whole seed. Over 75% of the total legumes produced in the country is split into dal. Pulse processing is a small scale industry comprising of thousands of dal mills distributed throughout the country. Mills are mostly concentrated in producing areas such as Indore (Madhya Pradesh), Jalgaon and Akola (Maharashtra), and in other major cities such as Kolkata, Mumbai, Chennai, Hyderabad and Delhi. The Indian pulse milling process consists of several steps (see Fig. 11.3).

First the pulses are cleaned and the stones and mud are removed. Then, the surfaces of the pulses are scratched so that when they are soaked in a mixture of water and vegetable oil, it is easier to remove the husks during the grinding
1. CLEANING

2. DESTONING

3. CRACKING

4. SOAKING

5. DEHUSKING

6. SPLITING  ->  POLISHING  (DAL)

7. GRINDING  (BESAN)

process. Once the outer layer is removed, the pulses are split in half. To give a better finish, some processors polish the dal. Some pulses (mostly chickpea, urd and mung) are milled to make flour (besan). In the present economic structure, it is observed that if a consumer pays Rs 100 for Chickpea dal in India, under most favorable conditions the share of the farmer is only Rs 56 covering mostly the production loss (Rs.48), gaining only a marginal profit of 10%. The processor retains the remaining 44% for value adding and middleman of the trade. For unprocessed pulses, the grower gets about 10% of the share from total profit (Table 11.4).

In order to have value addition in pigeon pea and other pulses and thereby making more profit available to farmers for their produce, research efforts have been made by different organizations towards developing effective pre-milling treatments for loosening the seed coat of pigeon pea grain so as to facilitate milling process on one hand and develop low capacity dal mills to cater to the needs of crop producing centres on the other. As a result of these efforts a good
number of designs of low capacity *dal* mills have been developed by different R&D institutions and private sector units as well.

**TABLE 11.4: Distribution pattern of amount paid by a Consumer for unprocessed pulses and processed pulses between the Farmer and the Processor/ Middleman.**

*(Share of Rs100 paid by Consumer for commodity)*

<table>
<thead>
<tr>
<th>Description</th>
<th>Unprocessed Pulses</th>
<th>Processed Pulses (<em>dal</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>Farmer</td>
<td>70</td>
<td>56</td>
</tr>
<tr>
<td>Cost of production to farmer</td>
<td>60</td>
<td>48</td>
</tr>
<tr>
<td>Profit to farmer</td>
<td>10</td>
<td>08</td>
</tr>
</tbody>
</table>

*Source: - Alam (1996)*

Some *dal* mills perform better on some grains while others are suitable for other grains. In general, they are in the capacity range of 75 to 150 kg/ha. They vary in price also. Proper selection has, therefore, to be made based upon the grains to be milled and the availability of fund. IIPR *Dal Chakki* is a good choice both from the economic point of view as well as versatility of grain milling and ease of operation.

These *Dal* mills directly or indirectly result in employment generation and entrepreneurship development at rural level. Post harvest technology is commodity and location specific. However, present and immediate requirement is to popularize already developed need based and market driven post harvest technologies and equipment for loss prevention and value addition to markets. A pulse miller doing custom milling near Mumbai charges 100 to 150 rupees per ton (depending on the type of pulse) as a milling charge (at an assured 85% recovery rate). The miller to be sold as cattle feed retains the pulse husk and other by-products. As a rule of thumb the trade charges 300 rupees per metric tonnes as the cost of splitting. There is very little canning or dehydration of pulses.
11.4 VALUE ADDITION IN PULSES’ PROCESSING

The two major goals of post harvest technology are losses prevention and value addition to the raw food commodities through preservation and processing. Raw food materials are cleaned, graded and then conditioned either for storage or processing. Processing is done to make raw commodities edible through primary or secondary processing and ready to eat through secondary and tertiary processing.

At every stage of processing, value is added to the product. Estimated value additions to the raw food materials through primary and secondary/tertiary processing in India are 75% and 25% respectively\(^\text{10}\). It therefore shows that primary processing has a greater role to play in improving the economic benefits to the farmers. The process of industrialization in the country is changing the structure of rural economy. Concentrating the agricultural produce, processing and value addition and its trade to urban areas will make farmers merely producers of raw materials. There is an urgent need, therefore, to change this scenario.

Seventy-five percent of pulses produced in India are processed; therefore post harvest technology plays an important role in per capita availability. Pulse processing units vary in size from cottage industries to multi-storey plants using pneumatic conveyors. The steps involved in *dal* or *besan* making at home or in mills are the following:

1) Cleaning (removing of foreign matter from pulse grain)
2) Dampening (soaking of the grain in water for desired time)
3) Tempering (keeping soaked grain for sun drying)
4) Splitting (grinding of grain to make *dal*)
5) Husking ((removal of husk from *dal*)
6) Grinding of *dal* (broken or otherwise) is done to convert it into *besan* (flour)

Processing of *dal* is the second largest food processing industry after rice and flour milling. There are approximately 10,000 pulse mills with 10-20 tons per day processing capacity and an annual turnover of Rs. 45,000 crores\(^\text{11}\). They are privately owned. They work on an average for 200-250 days per year. The
majority of *dal* mills use conventional technology with locally fabricated machinery which consumes high electricity and time and they are labor-intensive. Output of the *dal* mills depends on the availability of raw material, capital and energy, and also the capacity of the mill and the number of working days. The major portion of the pulses processed is milled by the *dal* mills with daily capacity ranging from 0.5 ton to 10 tons per day. Packing and storage of *dal* is related with loss of quantity as well as quality. The packing material is seldom of good quality.

The pulses contain 11-14% husk and 2-5% germ and rest is the seed-endosperm. The extraction rates of processing are between 70 and 88% of raw material. The main by-products of pulse milling are in the form of brokens (6-13%), mixture of germ and powder (7-12%) and husk (4-14%) . Small brokens and husk are used as cattle feed, brokens are either used for human consumption, as an ingredient in cattle feed or fed to swans and elephants. Husks of lentils are used in poultry feed, brokens of Bengal gram are fed to horses and used in *besan* preparations. Brokens of pulses are milled to produce flour and are used in *papad* preparations.

The major issues and constraints in the processing industry in India are summarized as below:

1) Faulty layout of machinery (design does not meet specifications or exact requirements of grain properties)
2) Lack of storage facility, rodent and insect infestation during post harvest handling, storage and distribution cause substantial losses both qualitatively and quantitatively. Birds and rodents account for considerable losses during drying and storage.
3) Sun drying practices result in lengthy processing line and complete dependence on climatic condition
4) Limitations of drying yard facilities
5) Fluctuations in the availability of raw materials and their milling characteristics
6) Arbitrary use of oil and water
7) High labor requirements
8) Low yield and poor quality dal of mills
9) Very low equipment utilization and high cost of processing
10) Dust pollution inside the mill
11) Costly packaging material
12) Lack of awareness of modern dal milling technology available in India.

11.5 BYPRODUCT UTILIZATION IN MILLING PULSES

Various byproducts which come out from the milling of pulses include different fractions of pulses and need to be separated from the whole/split pulse. These byproducts of dal milling like husk, powder and small brokens are usually sold as cattle feed. The pulses husk has been traditionally used as the cattle feed because of their low bulk density and it forms about 10% of the raw material which is sold as cattle feed at a lower price\(^{14}\). The dal powder and small brokens which are richer in nutrients are sold at a higher price, also for the cattle feed.

11.6 VALUE ADDITION IN PACKAGING

Packaging is an important function in the marketing of pulses. It is a practice to protect the produce from any damage during storage, transportation and other marketing operations. In recent years, Packaging plays an important role in the marketing of produce. Packaging also has a great potential for value addition in pulses marketing. Pulses should be packaged in containers which will safeguard the hygienic, nutritional, technological and intrinsic qualities of the product. When the product is packaged in sacks, these must be clean, sturdy and strongly sewn or sealed. The containers, including, packaging material should be made of substances which are safe and suitable for their intended use. They should not impart any toxic substance or undesirable odor or flavor to the product. A properly graded and packed grain not only facilitates convenience in transportation and storage but also attracts consumer to pay more and hence fetches more income from the farm produce.
11.7 VALUE ADDITION IN STORAGE

Storage of pulses has been considered as the most crucial factor, among all post harvest operations, due to losses caused by insect infestation. Storage alone contributes 7.5% of total post harvest losses, which are in total to the tune of 25-30%\textsuperscript{15}. Traditionally, storage is done in jute bags, *Thekka*, mud and metal bins with application of insecticides, fumigation and aeration. Since long back, controlled or modified storage structures were being used in the form of airtight structures, but their scientific studies have taken momentum in recent past.

The following requirements should be fulfilled for safe storage of pulses:

11.7.1 Selection of site (location)

The storage structure should be located on a raised well-drained place. It should be easily accessible. The storage structure should be protected from humidity, excessive heat, direct sunrays, insect and rodents.

11.7.2 Selection of storage structure

The storage structure should be selected according to the quantity of pulses to be stored.

11.7.3 Cleaning of storage structures

The storage structures should be properly cleaned before storing pulses. There should be no left over grains, cracks, holes and crevices in structure, which may be harbor of insects. Before storage, the storage structure should be fumigated.

11.7.4 Cleaning and Drying

Before storage, the pulses should be properly cleaned and dried. Grains should be free from foreign matters and excessive moisture to avoid quality deterioration and pest attack.

11.7.5 Cleaning of bags:

As far as possible, new gunny bags should be used. The old gunny bags should be properly cleaned, dried and fumigated before use.
11.7.6 **Separate storage of new and old stock:**

To check infestation and to maintain hygienic condition of godown, the new and old stock should be stored separately.

11.7.7 **Cleaning of vehicles:**

The vehicles used for transporting pulses should be properly cleaned with phenyl.

11.7.8 **Use of dunnage:**

Dunnage should be used before stacking bags to avoid absorption of moisture from floor. Bags should be kept on wooden crates or bamboo mats preferably along with a cover of polythene sheet.

11.7.9 **Proper aeration:**

There should be proper aeration during clear weather condition but care should be taken to avoid aeration during rainy season.

11.7.10 **Regular inspection:**

Regular inspection of stored pulses should be carried out to check infestation. It is necessary to maintain proper health and hygiene of the stock.

11.8 **VALUE ADDITION EFFORT IN PULSES MARKETING**

The global consumer demand for high quality pulses that are both fresh tasting and nutritious has created considerable interest. Investment in the development of new and improved post harvest storage, processing and value addition methods in marketing pulses crops has been initiated. The competitive struggle for markets, which has resulted from more liberalized trade regimes, has required a much greater emphasis on efficient and effective post harvest handling, processing, storage and distribution to access markets further and further. Fresh pack and minimally processed products of pulses are developing gradually. The marketing concept for minimally processed pulses is based on the perceived consumer’s desire for more natural, less processed and high quality homemade style preparations. Chilled ready to eat foods are very rapidly growing into a new
segment of the market. It has to take care of nutrition, coloration, dehulling, cooking properties and moisture in developing quality standards in respect of such items. Efforts are on to make value added products such as bread and snack food to increase prevailing pulses demand and to enhance their nutritional value and starch from pulses for use in the proper industries. For example the pulses in Australia have generally been used by the stock feed industry and any human consumption has been in a pre cooked form such as baked bean, hence pulses have unfortunately been seen by some, quite wrongly, as poor quality food.

Most pulses are high in the oligosaccharides raffinose, stachyose and verbascose which cause flatulence. This problem combined with the long cooking times required to prepare them and the fact that they are usually only available in cans or as sauces has given pulses a poor marketing image as human food. Supermarket snack foods have rarely a pulse component. In contrast South-east Asian countries have top selling snacks made from pulses.

Although this segment of the market is declining due to popularity of western style chips, there is still a huge market potential for such products. Pulses have a huge potential in extruded snack foods. They offer a good base for the extruded product as they produce a good flavor which is not overpowering, when heated. They lend themselves to flavor addition and retain a good crunch if treated and stored properly. Pulses can also be used in breakfast as “breakfast cereals” with added nuts or fruits. Breakfast bars are the home meal replacement option for breakfast. Both present an ideal opportunity for value adding with pulses. The addition of pulses which have been treated to remove any unusual flavors and softened for easy eating could differentiate a market cluttered with a range of products which are similar to one another. Pre-prepared meals are one of the fastest growing segments of the retail market. Manufacturers seek flavor, appearance and an ability to retain texture and color when reheated from a frozen or cold state. Consumers want these properties as well as healthy nutritious product. Many pulses can satisfy these requirements. They can add a valuable source of carbohydrates and proteins to a meal along with other positive
nutritional benefits. Pulses which are ready to cook and eat quickly are another potential growth area. Pre cooking and correct packaging is key to sales in this area. Pulses are a good source of carbohydrate, protein, fibre and calcium iron, thiamine and riboflavin. With correct processing and packaging, pulse products can be sold as health supplements in supermarkets or health food stores. This is a specialty market but with the appropriate scientific backing, could be profitable. It could also be used as face packs in beauty parlors to lend shine to skin etc.

While marketing pulses, regional, seasonal and varietal differences must be taken care of. Consumers in Tamil Nadu and Bihar states appreciate a deep yellow color in dal. For this, dal is mixed with yellow color additives (even non permitted dyes) in water solution, dried and sold. This method of coloring is also used by millers to mask small patches of husk remaining on the dal, due to incomplete milling. In western and north-western India, consumers prefer an oily looking dal, for which an extra oil coating is given to the finished dal. This imparts an oily shine to the product.

Unfortunately the pulse industry is competing in the market with many alternatives and therefore needs to differentiate itself. The key is to be imaginative and highlight the differences in pulses, rather than to make them look the same and have the same effect as an existing product.

11.9 CONSUMER PREFERENCE FOR VALUE ADDITION

The consumer preferences have been analysed by the survey results conducted in the four cities of North India. Table 11 A shows the perception of the prices that consumers hold about pulses .It is clearly indicated that 38.5% respondents report that the average prices of pulses are premium. Only 4.75% respondents consider prices of pulses to be low. Chi -square value shows significant difference among the respondents on price perception. (Chi-square value= 0.936)

It implies that marketers need to revise prices to bring it in consonance with the consumers’ perceived level. This step may boost the sales of these products.
Table 11 A: Prices of Pulses as felt by consumers of different cities

<table>
<thead>
<tr>
<th>Variable</th>
<th>Srinagar</th>
<th>Ludhiana</th>
<th>Delhi</th>
<th>Aligarh</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>37</td>
<td>26</td>
<td>21</td>
<td>35</td>
<td>119 (29.75%)</td>
</tr>
<tr>
<td>Premium</td>
<td>44</td>
<td>38</td>
<td>29</td>
<td>43</td>
<td>154 (38.5%)</td>
</tr>
<tr>
<td>Appropriate</td>
<td>10</td>
<td>21</td>
<td>24</td>
<td>13</td>
<td>68 (17%)</td>
</tr>
<tr>
<td>Attractive</td>
<td>7</td>
<td>11</td>
<td>16</td>
<td>6</td>
<td>40 (10%)</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>3</td>
<td>19 (4.75%)</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>Score</td>
<td>107</td>
<td>71</td>
<td>35</td>
<td>101</td>
<td>314</td>
</tr>
<tr>
<td>Rating</td>
<td>1.07</td>
<td>0.71</td>
<td>0.35</td>
<td>1.01</td>
<td>0.785</td>
</tr>
</tbody>
</table>

A study of Table 11 B shows that 19.75% of respondents from all the cities under study rarely use branded pulses. It is because strong national brands in pulses are almost non-existent in India. 23% respondents of Delhi say that they always buy branded pulses since Delhites are more brand conscious. Least is recorded in Aligarh (9%) as the respondents are price conscious and prefer loose supply for convenience. On the whole 28.5% of respondents from all cities show that they never use branded pulses.

Table 11 C shows the possibility of consumers for switching over to new branded and improved pulses even at a premium price. 37.5% respondents from the sampled population report that they will possibly switch over. 27% of respondents from Delhi will certainly try new products. The reason is Delhites are more brand conscious and willing to try new products. There is a segment of people (12.25%) who are price sensitive and are reluctant to switch over brands once they are satisfied with the one in use. There are still some who will never switch over (7.25%). There is significant difference among the consumers in the possibility of switching over to new branded pulses even at a premium price. (Chi-square value = 0.716)
Table 11 B: Consumers Response towards use of Branded Pulses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Srinagar</th>
<th>Ludhiana</th>
<th>Delhi</th>
<th>Aligarh</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>11</td>
<td>14</td>
<td>23</td>
<td>9</td>
<td>57 (14.25%)</td>
</tr>
<tr>
<td>Usually</td>
<td>15</td>
<td>20</td>
<td>27</td>
<td>15</td>
<td>77 (19.25%)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>14</td>
<td>23</td>
<td>21</td>
<td>16</td>
<td>74 (18.5%)</td>
</tr>
<tr>
<td>Rarely</td>
<td>27</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>79 (19.75%)</td>
</tr>
<tr>
<td>Never</td>
<td>33</td>
<td>21</td>
<td>20</td>
<td>39</td>
<td>113 (28.25%)</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>Score</td>
<td>-56</td>
<td>-16</td>
<td>24</td>
<td>-66</td>
<td>-114</td>
</tr>
<tr>
<td>Rating</td>
<td>-0.53</td>
<td>-0.16</td>
<td>0.24</td>
<td>-0.66</td>
<td>-0.285</td>
</tr>
</tbody>
</table>

Table 11 C: Possibility of switching over to new Branded Pulses even at a premium price

<table>
<thead>
<tr>
<th>Variable</th>
<th>Srinagar</th>
<th>Ludhiana</th>
<th>Delhi</th>
<th>Aligarh</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certainly</td>
<td>11</td>
<td>17</td>
<td>27</td>
<td>8</td>
<td>63 (15.75%)</td>
</tr>
<tr>
<td>Very likely</td>
<td>19</td>
<td>28</td>
<td>39</td>
<td>24</td>
<td>110 (27.5%)</td>
</tr>
<tr>
<td>Possibly</td>
<td>47</td>
<td>31</td>
<td>28</td>
<td>43</td>
<td>149 (37.25%)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>15</td>
<td>18</td>
<td>5</td>
<td>11</td>
<td>49 (12.25%)</td>
</tr>
<tr>
<td>Never</td>
<td>8</td>
<td>6</td>
<td>1</td>
<td>14</td>
<td>29 (7.25%)</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>Score</td>
<td>10</td>
<td>32</td>
<td>86</td>
<td>1</td>
<td>129</td>
</tr>
<tr>
<td>Rating</td>
<td>0.10</td>
<td>0.32</td>
<td>0.86</td>
<td>0.01</td>
<td>0.3225</td>
</tr>
</tbody>
</table>

Marketeters need to come up with different strategies for different class of cities to meet the consumers’ preferences and attract new ones and retain the loyalties of the existing ones.
Table 11 D indicates clearly the family size-wise consumer’s responses towards new products of pulses. Nuclear families will be more responsive in trying new products as compared to joint and large families. On the whole 37.25% respondents agree that they would possibly buy new products. The consumers are significantly different in their response towards new products. (chi-square value = 0.820)

Table 11 D: Possibility for switching over to Branded Pulses by family size of the respondents

<table>
<thead>
<tr>
<th>Possibility for switching over to branded products</th>
<th>Family size</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certainly</td>
<td>Less than 4</td>
<td>21</td>
<td>19</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>5 - 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 - 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very likely</td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possibly</td>
<td>Less than 4</td>
<td>57</td>
<td>38</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>5 - 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 - 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlikely</td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>Less than 4</td>
<td>17</td>
<td>12</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>5 - 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 - 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Score</td>
<td>68</td>
<td>38</td>
<td>35</td>
<td>-12</td>
</tr>
<tr>
<td>Rating</td>
<td>Rating</td>
<td>0.479</td>
<td>0.333</td>
<td>0.460</td>
<td>-0.18</td>
</tr>
</tbody>
</table>

Table 11 E clearly indicates the characteristics of pulses more desired by consumers for improvement and value addition. Different characteristics were rated on high, moderate and low scale. Cleanliness and Hygiene was given the highest priority for improvement (64%) followed by branding (62.75%) which indicates enough scope for improvement in such features. Packaging is another area which deserves more attention for adding value in pulses (53.75%). Flavoring and preservation do not have enough relevance in pulses as such except in case of pulses products like snacks, ready-to-eat dal, etc.
Table no 11 E: Characteristics of Pulses more desired by consumers for improvement and value addition

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness and Hygiene</td>
<td>256 (64%)</td>
<td>144 (36%)</td>
<td>-</td>
</tr>
<tr>
<td>Grading</td>
<td>169 (42.25%)</td>
<td>221 (55.25%)</td>
<td>10 (2.5%)</td>
</tr>
<tr>
<td>Coloring</td>
<td>145 (36.25%)</td>
<td>186 (46.5%)</td>
<td>69 (17.25%)</td>
</tr>
<tr>
<td>Flavouring</td>
<td>90 (22.5%)</td>
<td>103 (25.75%)</td>
<td>207 (51.75%)</td>
</tr>
<tr>
<td>Preservation</td>
<td>43 (10.75%)</td>
<td>95 (23.75%)</td>
<td>262 (65.5%)</td>
</tr>
<tr>
<td>Branding</td>
<td>251 (62.75%)</td>
<td>133 (33.25%)</td>
<td>16 (4%)</td>
</tr>
<tr>
<td>Labeling</td>
<td>187 (46.75%)</td>
<td>201 (50.25%)</td>
<td>12 (3%)</td>
</tr>
<tr>
<td>Packaging</td>
<td>215 (53.75%)</td>
<td>175 (43.75%)</td>
<td>10 (2.5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Score</th>
<th>Rating</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness and Hygiene</td>
<td>1056</td>
<td>2.64</td>
<td>1</td>
</tr>
<tr>
<td>Grading</td>
<td>959</td>
<td>2.397</td>
<td>5</td>
</tr>
<tr>
<td>Coloring</td>
<td>731</td>
<td>1.827</td>
<td>6</td>
</tr>
<tr>
<td>Flavoring</td>
<td>683</td>
<td>1.7075</td>
<td>7</td>
</tr>
<tr>
<td>Preservation</td>
<td>581</td>
<td>1.452</td>
<td>8</td>
</tr>
<tr>
<td>Branding</td>
<td>1035</td>
<td>2.587</td>
<td>2</td>
</tr>
<tr>
<td>Labeling</td>
<td>975</td>
<td>2.437</td>
<td>4</td>
</tr>
<tr>
<td>Packaging</td>
<td>1005</td>
<td>2.512</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product Attribute</th>
<th>Ranks for the existing product</th>
<th>Ranks for the value addition and improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness and Hygiene</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Grading</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Coloring</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Flavoring</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>preservation</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Branding</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Labeling</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Packaging</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

rs = 0.667
The value of rank correlation \((rs = 0.667)\) indicates that the relationship between the characteristics of pulses more desired in the existing products and the characteristics desired for value addition and improvement is highly positive.

11.10 HYPOTHESES TESTING

**Ho5: The post harvest losses in pulses are substantial which can be reduced significantly by focusing on a few stages.**

As is evident from **Table 11.1, 11.2 and 11.3**, there is a sizeable quantitative and qualitative loss of pulses during different post-harvest operations like threshing, winnowing, transportation, processing and storage. As in **Table 11.2** and **11.3**, about 2.46% and 2.38% losses occurred during post harvest operations in Black gram and Green gram respectively.

**The hypothesis is therefore accepted.**

**Ho12: Consumers are prepared to pay extra price for certain value additions in pulses.**

As evident from the analysis of tables 11 C and 11 D earlier, consumers are willing to switch over to new branded and improved products even at a premium price. 37.5% respondents from the sampled population report that they will possibly switch over. 27.5% say that they will very likely switch over and 15.75% say that they will certainly do so. Very few respondents from the sampled population report that they will never try new products (7.25%). 27% of respondents from Delhi will certainly try new products.

**We therefore accept the hypothesis.**

**Ho13: Good packaging, branding, and labeling in marketing of pulses will substantially enhance the value of pulses in the eyes of the consumers.**

**Table 11 E** (analysed in the earlier section) clearly indicates the characteristics of pulses more desired by consumers for improvement and value addition. Different characteristics which were rated on top include (in the same order) Cleanliness and Hygiene, Branding, Packaging and Labeling. These three
being on ranks 2, 3 and 4 have been recommended by the surveyed consumers. Therefore we accept the hypothesis.

11.11 CONCLUSION

The post harvest technology in pulses in recent times has attracted attention as a powerful tool for rural industrialization. There is a sizeable quantitative and qualitative loss of pulses during different post-harvest stages. Hence, it is appropriate to give due emphasis to reduce qualitative as well as quantitative losses of pulses during post-harvest operations. With the onset of industrialization most of the processing activities have been shifted to urban areas where infrastructural facilities are available. There is a strong need to reverse this trend and create means to increase income of rural people and generate employment opportunities in rural areas. Processing and value addition can be very powerful tools to achieve this goal. It provides an important opportunity for marketers that they should come up with strong brands in pulses to make consumers loyal to them by emphasizing on image building of the brands. The onus solely lies on the marketers, to orchestrate effective campaigns and deliver quality products to create brand loyalty among the consumers. Marketers also need to revise prices to bring it in consonance with the consumers' perceived level. This step may boost the sales of these products. Marketers need to come up with different strategies for different class of cities to meet consumers' preferences and win their favor and retain their loyalties.

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